4.11 Utilities and Energy

4.11.1 Introduction

This section describes the environmental setting for Utilities and Energy. The Utilities section of the EIR explains the distribution of the utilities used within California and those potentially affected by the VTP program. These include electricity, water, and renewable energy sources that include biomass, hydro, wind, and geothermal.

Utilities (transmission lines, substations, etc.) and water supply facilities are at risk to wildfires. Wildfires have the potential to damage or destroy transmission lines. Depending on the extent of the damage the impact to transmission lines from a wildfire could have a cascading effect across the energy grid. High severity wildfires as well as prescribed fire have the potential to affect the capacity of water storage through accelerated erosion and sedimentation. The fuel reduction and brush removal the Vegetation Treatment Program can reduce the risk of high severity fires occurring in areas that are likely to impact utilities or water supply. The following is a summary of key issues regarding the importance of the VTP to protect utilities and enhance energy production from a renewable source.

- Utilities are an asset at risk (esp. transmission lines, substations, wind generation and maybe geothermal facilities; they can be threatened by wildfire, and escaped prescribed fire could be an issue).
- Hydro facilities generate electricity, as well as store water. Vegetation Management can increase runoff that is favorable to electricity generation and storage; it can also cause sedimentation that helps fill in reservoirs and gum up generators.
- Mechanical Treatment of Vegetation generates biomass. Some can be used for electricity generation or thermal applications that offset fossil fuel use.

4.11.2 Regulatory Setting

A number of different agencies regulate utilities and energy production in California. These agencies do not have direct oversight over the Vegetation Treatment Program. However, their oversight and policy decisions can influence infrastructure needs which in turn may indirectly have a greater influence on the VTP. This would be particularly true if policy decisions lead to a greater emphasis on biomass and other renewable energy sources.

Potential Responsible Agencies include:

- Public Utilities Commission (PUC) (www.cpuc.ca.gov) for projects requiring permits to construct an electric transmission line, a water utility, a radio-telephone utility, or facilities for operating a passenger transportation service;

- California Electricity Oversight Board (www.eob.co.gov) ensures transmission reliability through overseeing operations of the California Independent System Operator (CAISO), ensures fair market prices, and monitors daily market variations.

- California Integrated Waste Management Board (www.ciwmb.ca.gov) would be a Responsible Agency (or any other applicable enforcement agency) for projects requiring permits to operate a transfer, disposal, or waste-to-energy facility;
- Local utility providers.
- California ISO (www.caiso.com) is the impartial link between power plants and the utilities that serve more than 30 million consumers. The ISO provides equal access to the grid for all qualified users and strategically plans for the transmission needs of this vital infrastructure.
- California Energy Commission (www.energy.ca.gov) is the State's primary energy policy and planning agency. The Commission has major responsibilities that include: forecasting future energy needs, licensing thermal power plants 50 megawatts or larger, promoting energy efficiency, developing energy technologies and supporting renewable energy, and planning for and directing state response to energy emergency.

4.11.3 Electricity - Transmission Lines

California's electrical transmission and distribution system consists of power plants, substations transmission lines, electric utility service areas, and electrical transmission busses. Power lines are a critical infrastructure of California's energy system and a seemingly ubiquitous part of the landscape. Right-of-way corridors associated with transmission lines are normally between 150 to 300 feet wide (CEC, 2004). They are managed to prevent tall growing trees and other vegetation that could interact with conductors and interfere with the ultimate management goal of providing safe and reliable transmission of electricity. With about 40,000 miles of transmission line in California (Figure 4.11.1), they represent a prominent and expanding infrastructure on the landscape. Table 4.11.1 and Table 4.11.2 provide a summary of the length of transmission lines by Bioregion and by ownership. With the increasing interest in renewable energy resources it is likely that additional transmission lines will need to be located in forest and range lands across the state. Wildfires have the potential to damage or destroy transmission lines. Depending on the extent of the damage the impact to transmission lines from a wildfire could have a cascading effect across the energy grid.

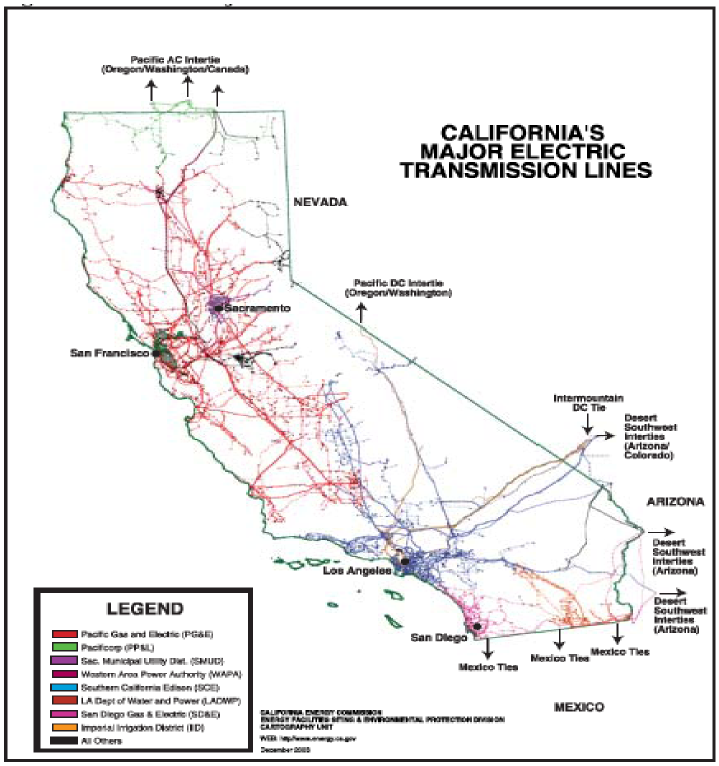

Figure 4.11.1 California's major electric transmission lines

Table 4.11.1 **Length of Transmission Lines by Bioregion**	
Bioregion	Miles
Bay Area/Delta	7869
Central Coast	3586
Colorado Desert	2808
Klamath/North Coast	2953
Modoc	1608
Mojave	5470
Sacramento Valley	6119
San Joaquin Valley	7967
Sierra	5993
South Coast	9834

Table 4.11.2
Length of Transmission Lines by Ownership

Transmission Line Owners	Circuit Miles	Percent of State Total	ISO-Controlled Grid IOU-Only Ownership
PG and E	18491	58.3	72.4
Edison	5129	16.2	20.1
SDGE	1906	6	7.5
Municipal Utilities	5224	16.5	
Federal (Western Area Power Administration)	971	3.1	
Total State Transmission Line Mileage	31721	100	
IOU Only Mileage as Proportion of Total		80.5	25526

4.11.4 Water Infrastructure

To accommodate a large population and to account for highly variable rainfall, California has a highly developed infrastructure. The California State Water Project consists of an extensive storage and conveyance system that includes pumping and power plants, reservoirs, lakes, storage facilities, aqueducts, canals, and pipelines that distribute water through 29 different water agencies. The location of dams, reservoirs and canals reflects the spatial distribution of precipitation. Many of the dams are located in forest landscapes (Figure 4.11.2). The State's water is concentrated in the north, 75% of precipitation occurs north of Sacramento, but the majority of the urban population and much of the irrigated agriculture are in the south. California's water storage also meets multiple objectives that include: compensating for annual and seasonal variations in water supply, providing protection, and providing recreational opportunities. The two major water projects in California are the State Water Project and the Central Valley Water Project. Oroville dam is the main storage facility for the State Water Project. The two main storage facilities for the Central Valley Water Projects are Shasta dam and Friant dam. In addition, there are an estimated 1200 nonfederal dams with a reservoir capacity of 20 million acre feet (MAF) (Mount, 1995). Combined with 181 federal reservoirs the total capacity is roughly 42 MAF and captures almost 60 percent of the runoff. The water from these dams is distributed across the state through a complex system of canals and aqueducts that stretches for several thousand miles across the state. High severity wildfires have the potential to affect the capacity of water storage through accelerated erosion and sedimentation.

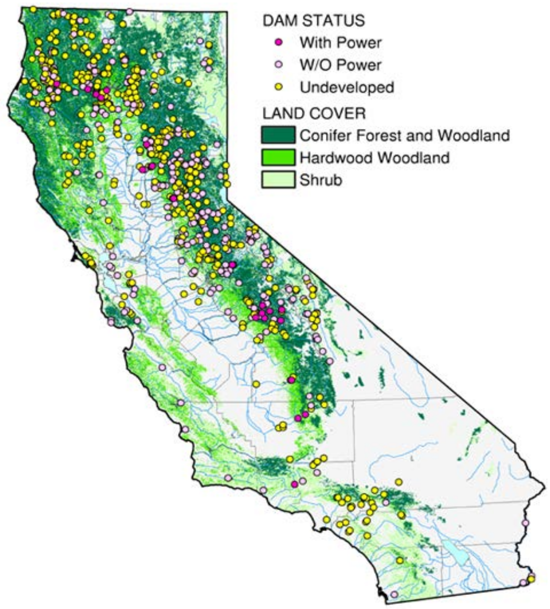

Figure 4.11.2 California dams and their power status. (DOE, 1998).

4.11.5 Energy Production and Use

With its large and growing population California consumes more energy (264,740 Gigawatt hours) than any other state. It is also a world leader in electricity created by renewable energy resources and energy conservation. California has the lowest per capita energy consumption of any of the 50 states (see CEC web site). This section describes the environmental setting for energy production that is developed on forest and range lands and is potentially affected by fuel reduction projects and wildfires.

California's forests and rangelands provide electrical generation from several sources. These include electricity from hydropower, geothermal, wind, biomass, and solar. Urban wood wastes also contribute to production of electricity to the extent they are buried in landfills and landfill gas is captured and used to help generate electricity.

California relies on three sources of energy—petroleum, natural gas, and electricity (California Energy Commission web site). California's electricity system includes over 1,000 power plants that provide power to customers through 27,000 circuit-miles of transmission lines (Figure 4.11.1). California's power generation system is owned by numerous entities, with about 44 percent of total generation owned by investor-owned and municipal utilities plus other entities (CEC, 2001a).

The two largest suppliers for forest and rangeland areas are Pacific Gas and Electric (PG&E) and Southern California Edison (SCE). However, most of the existing power plants once owned by PG&E, San Diego Gas and Electric (SDG&E), and SCE were sold. New plant owners, as well as new plants that will be built in California, are not required to provide electricity to the State. Since deregulation in 1996, the CEC has approved applications for new large power plants that will generate about

20,000 megawatts (MWs). Another 20,000 MWs of proposed capacity is under review by the CEC or may be submitted by developers in the near future.

4.11.6 Forest and Range Related Energy Industry Structure

California's electric generation comes from multiple sources (Table 4.11.3). In 2005, Natural Gas, Coal, Large Hydro, and Nuclear Power comprised 89% of the fuel type used to generate electricity, while renewable sources (biomass, geothermal, small hydro, solar, and wind) accounted for 11%.

Table 4.11.3
Gross System Electricity Production by Resource Type (CEC, 2005)

Fuel Type	In-State	NW Imports	SW Imports	GSP	GSP Percent
Coal*	28,129	4,926	24,796	57,851	20.10
Large Hydro	34,500	12,883	1,701	49,084	17.00
Natural Gas	96,088	1,786	10,812	108,686	37.70
Nuclear	36,155	691	4,861	41,707	14.50
Renewables	30,916	0	0	30,916	10.70
Biomass	6,045			6,045	2.10
Geothermal	14,379			14,379	5.00
Small Hydro	5,386			5,386	1.90
Solar[1]	660			660	0.20
Wind	4,446			4,446	1.50
Other	-0-			0	0.00
Total	**225,788**	**20,286**	**42,170**	**288,245**	**100.00**

**Amount of electricity produced from coal includes out-of-state power plants that are either owned by California utilities or have long term contracts to supply electricity solely to California. This electricity produced from these coal-fired plants is not designated as an "import" even though the plants are located outside the State. The 15 small coal-fired power plants located within California have a name plate capacity of only 550 MWs; less than one percent of total State capacity. Source: CEC, 2001b*

Energy contributions from forests and rangelands are primarily associated with electricity from hydropower, geothermal, wind, and biomass. Large hydro is not considered to be renewable and is defined as any facility employing one or more hydroelectric turbine generators, the sum capacity of which exceeds 30 MWs (CEC, 2001c). In contrast, small hydro (any facility employing one or more hydroelectric turbine generators with a sum capacity of 30 MW or less) is considered renewable. In 2001, renewables contributed 10.5 percent of California's electrical generation. Renewables include small hydro, biomass, geothermal, wind, and solar sources (Figures 4.11.3 and 4.11.4). The most significant contributions come from geothermal and biomass.

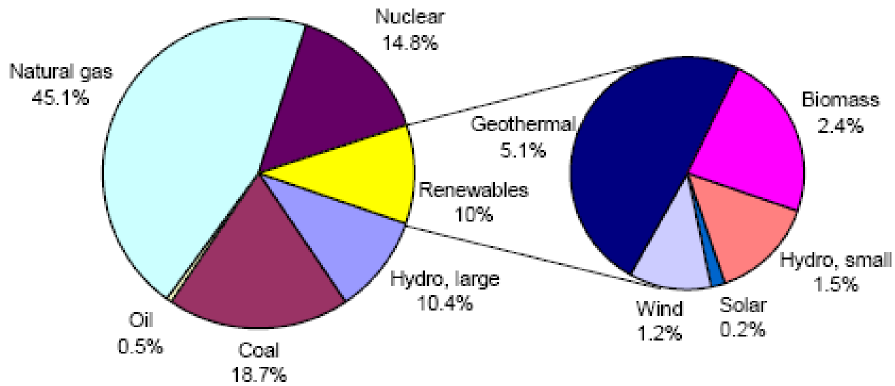

Figure 4.11.3 Percent of electric generation by fuel types in California (2001)

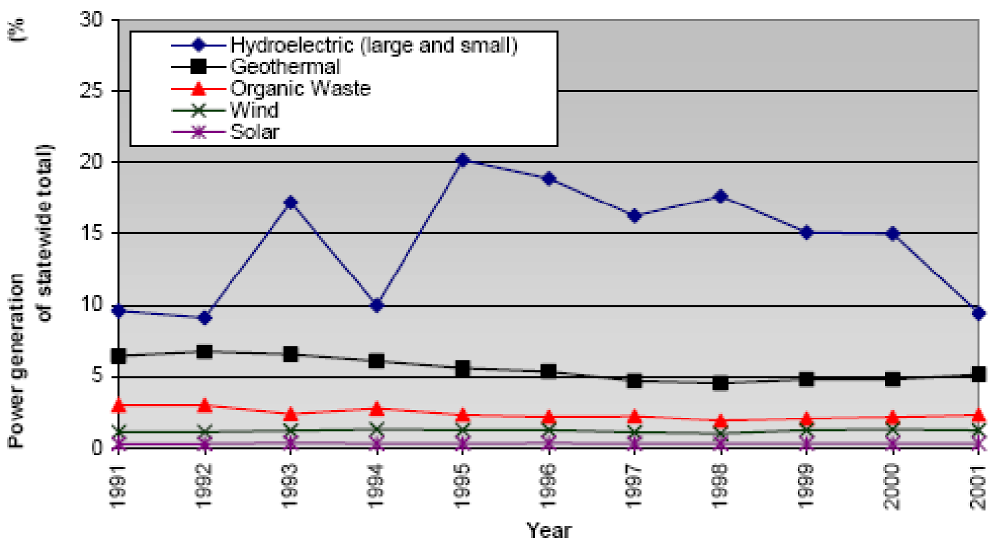

Figure 4.11.4 Percent of statewide annual total power generation for sources associated with forests and rangelands, 1991-2001

Hydro (both large and small), geothermal, biomass, and wind energy sources are related to forest and range resources. Over the last two decades, the relative importance of hydro, wind, biomass, and geothermal has varied. However over the last five years, the relative contribution of hydro has declined. Tables 4.11.4 and 4.11.5 summarize the amount and percent of megawatts produced from renewable sources.

Table 4.11.4
Megawatt Production from Online Power Plants by Bioregion and Plant Type, 2001

					WTE		
					Biomass		
Bioregion	Geothermal	Hydroelectric	Wind	Solar	Agriculture, animal waste, hog fuel, woodwaste	Woodwaste only	Digester gas, landfill gas and municipal solid waste
Bay Area/Delta	1,122	17	465	0	0	0	42
Central Coast	0	9	0	0	0	12	21
Colorado Desert	475	61	0	0	15	0	0
Modoc	2	26	0	0	0	66	0
Mojave	0	499	368	409	50	0	23
North Coast/Klamath	686	260	0	0	28	64	0
Sacramento Valley	0	3,708	0	3	70	124	6
San Joaquin Valley	0	3,580	982	1	136	1	47
Sierra	277	4,144	0	0	0	126	17
South Coast	0	1,813	0	0	0	0	237
California	2,562	14,117	1,815	413	298	392	393

Table 4.11.5
Percentage of Megawatt Production from Online Power Plants by Plant Type, 2001

					WTE		
					Biomass		
Bioregion	Geothermal	Hydroelectric	Wind	Solar	Agriculture, animal waste, hog fuel, woodwaste	Woodwaste only	Digester gas, landfill gas and municipal solid waste
Bay Area/Delta	44	0	26	0	0	0	11
Central Coast	0	0	0	0	0	3	5
Colorado Desert	19	0	0	0	5	0	0
Modoc	0	0	0	0	0	17	0
Mojave	0	4	20	99	17	0	6
North Coast/Klamath	27	2	0	0	9	16	0
Sacramento Valley	0	26	0	1	23	32	2
San Joaquin Valley	0	25	54	0	45	0	12
Sierra	11	29	0	0	0	32	4
South Coast	0	13	0	0	0	0	60
California	100	100	100	100	100	100	100

In 2005, geothermal accounted for roughly half of total renewable energy. Other significant sources of renewable energy are biomass (20%), small hydro (17%), wind (14%), and solar (2%). This does not count contributions from large hydro.

Hydro

Hydraulic turbines rotate as a result of water moving from a higher to a lower elevation and thus create hydroelectric power (CEC, 2001d). See the online document Hydroelectric Power in

California for more information. The water arrives from streams and rivers or is run through man-made facilities such as reservoirs, pipelines, and canals. Hydro power can be generated by conventional methods that create electricity from water flowing in one direction or by pumped storage methods in which water that is utilized to create electricity can be used again by pumping it back uphill. Conventional hydroelectric facilities can be dams or run-of-river. Dams increase the water level to make an elevation difference and flow pressure. Run-of-river facilities normally divert water from its natural channel to put it through a turbine, usually returning the water downstream (CEC, 2001d). From 1983 to 2001 hydroelectric generation in California has averaged 37,345 gigawatts per hour, a figure that is 15.2 percent of the total generation used (including imports) in California (CEC, 2002c). The ability of hydro to contribute to electrical generating capacity varies with each river system and is limited by the variability and distribution of rainfall (Figure 4.11.5). About 75 percent of the California's rainfall occurs north of Sacramento. Developed hydropower capacity is even more heavily concentrated in this area. Yet 75 percent of consumptive water usage is south of Sacramento. The upper Sacramento and Feather Rivers have the largest average runoffs. The Kings, Feather, and Upper Sacramento have the most reliable generation pattern. There are an estimated 386 hydroelectric power plants many of these are located in the Sierra Bioregion (Energy Commission, 1999).

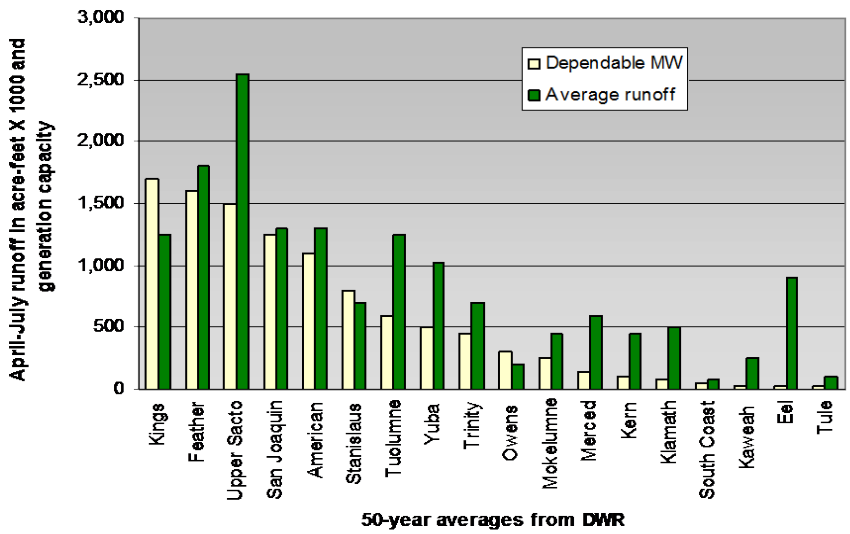

Figure 4.11.5 Hydroelectric plant capacity on California rivers

Geothermal

California now utilizes more than 2,500 MW of geothermal power generating capacity, 40 percent of which is located in the Geysers Resource Area of Northern California. A number of areas have been mapped as having potential for further geothermal development, most of which are on lands classified as forest and rangeland. CEC staff estimates perhaps an additional 3,000 to 4,000 MW of geothermal energy could be developed over the next decade.

Utilities and Energy

Wind

Wind-related power generation in California now has a capacity of more than 1,800 MW. It is concentrated on wind farms primarily in three areas: Altamont Pass (near Livermore), San Gorgonio Pass (near Palm Springs), and Tehachapi (in Kern County). Small consumer-owned wind projects exist in other parts of California as well. Another 950 MW is planned for the near future, though the total will be less due to repowering projects (American Wind Energy Association, 2002).

Biomass

Across California, woody biomass utilization plays a key role in forestry (CAL EPA, 2010; O'Neill et al., 2011). Concerns over rising energy costs, climate change, forest health and hazardous fuel buildups have led to executive orders and legislation that encourage the use of trees and woody plants as sources of energy. However, significant economic challenges exist. For instance, it is particularly expensive to haul heavy, moisture rich, low-energy wood over long distances (Becker et al., 2009a; Han et al., 2004). That predominant fact, along with other site-specific variables, such as forest type and condition, influences the market value for energy wood chips. Market forces dictate that low grade small diameter (8”-12”) trees and wood residues be chipped and used as fuel or sold for uses other than saw logs (Becker, et al., 2009; Evans, 2008; Evans and Finkral, 2009; Barbor et al., 2008). In scenarios where utilizing waste from commercial timber harvests offers to lower the future cost of fire suppression and/or meet other often-competing forestry management objectives, biomass projects potentially offer beneficial outcomes (Ager et al., 2010; Lowell et al., 2008; Mason, 2006; Snider, 2006).

A comprehensive economic assessment would take a closer look at how well biomass utilization meets those competing objectives, while using the tools of economic analysis to investigate the efficiency of biomass for energy. Thereby providing a reliable tool for land managers to use that helps to identify which use of the landscape yields the greatest overall *economic value*. [1] This is not such an analysis, since its scope is much narrower than that. To help provide a context for the role forest biomass could potentially play in meeting California’s renewable energy targets, estimates of land availability are first reviewed. Next, attention is placed on infrastructure capacity. Finally, we look at the current woody biomass industry use and its trends.

While there is a growing diversity of conceptual frameworks to think about biomass availability, (White, 2010; Malmshimer et al., 2011) the data currently available for biomass utilization in California from forests and rangelands can be broken down into four categories (California Energy Commission (CEC) and California Department of Forestry and Fire Protection (CAL FIRE, 2005). (1) Potentially available biomass (i.e. gross) represents the entire standing biomass within California. (2) Technically available biomass is the amount of biomass that might be used considering current or expected technology, steepness of terrain and legal/regulatory limitations to access. (3) Fire Threat Treatment Area (FTTA) represents the technically available biomass that, if removed, could reduce

[1] The *economic value* is the capacity of an economic good or service to make a positive difference in people’s lives. Its measure is the sacrifice individuals are willing to make or other valuable things they possess to obtain this particular good or service. Money flows and commercial markets need not be involved. The statement of economic value can be in barter or money terms.

the wildfire risks to natural and social resources. (4) Harvest potential represents the 5-year average biomass generated from current timber harvest activities.

Forests that are commercially logged produce an excess of waste wood fiber. Woody biomass fuel is all the organic material produced by plants in an urban or rural setting that can be burned directly as a heat source or converted into a gaseous or liquid fuel. Examples include chaparral and forest residues such as slash, mill waste and thinnings, hereafter referred to in this section as biomass. To be clear, the focus of this section is on the otherwise-unusable residuals materials produced from commercial timber harvests, vegetation treatment programs and milling operations. This section does not address biomass materials from agricultural crops and municipal solid wastes. The conceptual framework used in this discussion is represented below in Figure 4.11.6.

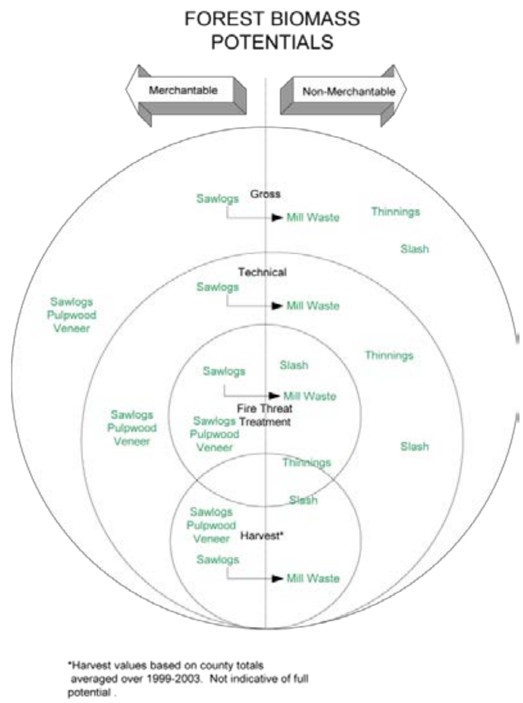

Figure 4.11.6 Conceptual framework

California has approximately 80 million acres of forest and rangelands (CAL FIRE, 2010). Nearly 33 million of which are forestlands, 45 percent of which are privately owned (ibid). The remaining 55 percent of forestland is owned by a mix of federal, State and non-governmental organizations (ibid). Forests and woodlands cover one third of California (Figure 4.11.7).

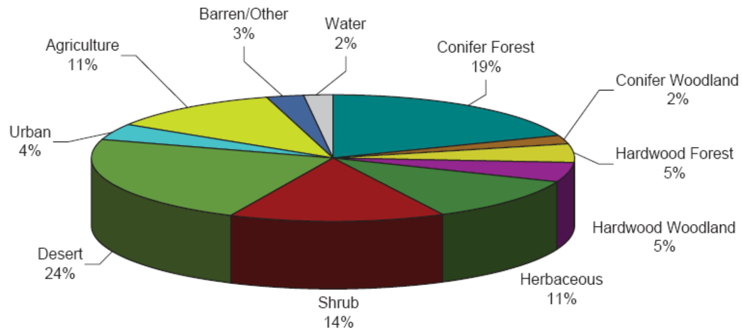

Figure 4.11.7 Percentage area of land cover classes, statewide

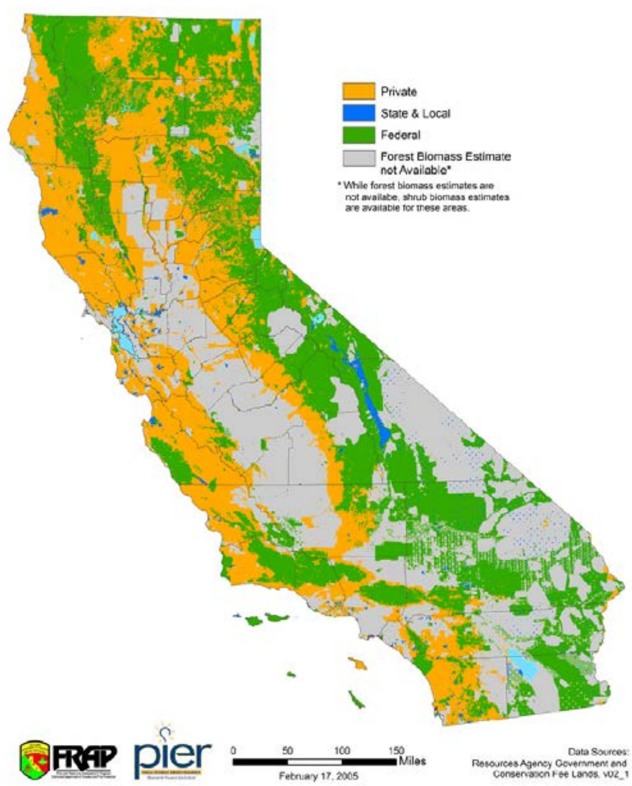

Figure 4.11.8 Ownership

The State's woody biomass availability is large and diverse with an estimated total standing inventory of 1,842 million bone dry tons (BDT) in all woody biomass categories (merchantable and non-merchantable), where 730 million BDT is from private lands, 1,093 million BDT is from federal lands, and 190 thousand BDT is from State and local lands (CEC and CAL FIRE, 2005). Although those figures are not what would actually be used as an energy source, since not all of these resources can, should, or will be used for power. This is an important point, because potential availability is much different from technically available biomass, Fire Threat Treatment Area (FTTA) biomass, or other categories of biomass availability. Currently, biomass is gathered from forestlands and is fed to boilers as fuel. Rangeland (shrub) biomass is currently not used as a commercial fuel source, and is only available when generated as a by-product of forest improvement activities.

Forestland biomass is classified the following way:

-*Logging slash*: Slash comprises branches, tops, and other materials removed from trees during timber harvest. Slash excludes the tree stem or “bole,” defined as from a one-foot stump to a four inch diameter top. Because the volume of slash is directly proportional to logging activity, slash as an energy resource has declined considerably in the state over recent years. Slash left on the ground after harvest can be a substantial source of surface fuels, which can carry wildfire and contribute to climate change as carbon is released during the decay process.

-*Forest thinnings*: Thinning refers to silvicultural treatments designed to reduce crowding and enhance overall forest health and fire resistance. Thinning of forest and shrub lands by mechanical means (other than by prescribed fire) is often emphasized when the intent is to reduce the threat of catastrophic wildfire near houses or other vulnerable assets and where air quality is a concern. Thinning may or may not produce merchantable saw logs (close to half of which may end up as mill waste). *Thinnings* are the non-merchantable components extracted during harvest activities and include understory brush, small diameter tree boles, and other material transported to the mill that cannot produce sawlogs. Harvesting brush and deadfall as well as limbs and tops requires a major modification of contemporary forest harvesting. For instance, current harvesting techniques involve skidding trees to the roadside where they are de-limbed and topped (Kumar et al., 2003). Brush and deadfall are currently left in place in forest. To utilize understory brush and deadfall will require harvesting operations to adopt innovative technologies.

-*Mill wastes*: Mill wastes are a byproduct of the milling of sawlogs, which consists generally of softwood tree boles with a diameter at breast height (dbh) of about ten inches. Mill wastes include sawdust, planer shavings, trim ends, and wood from other mill operations. Not all such residues are available for electric power generation to the grid because these materials have long been used for steam and power generation at the mill site. The resource ebbs and flows with domestic logging activity, and imports and exports have a minor impact on availability as well.

Forest residue from logging waste and thinning for fire hazard reduction present a much larger potential supply than just mill residues. However, in addition to the higher initial costs of transportation and processing associated with logging residue, it also has lower energy potential than mill residues due to higher water content. In either case, since commercial woody biomass resources originate in forests, timber harvests must inherently increase in order to expand technical availability (Abbas et al., 2011; Allen et al., 2002).

Total annual gross potentially available biomass in California is estimated at 27 million BDT (CEC and CAL FIRE, 2005; Williams, 2008). Although harvesting the entire gross potential is not likely because of environmental constraints, inaccessible terrain and other considerations. Gross potential availability is nonetheless included here to provide a starting point in which further discussion can be made possible. A map showing forest and chaparral areas from which gross potentials are realized is shown in Figure 4.11.9.

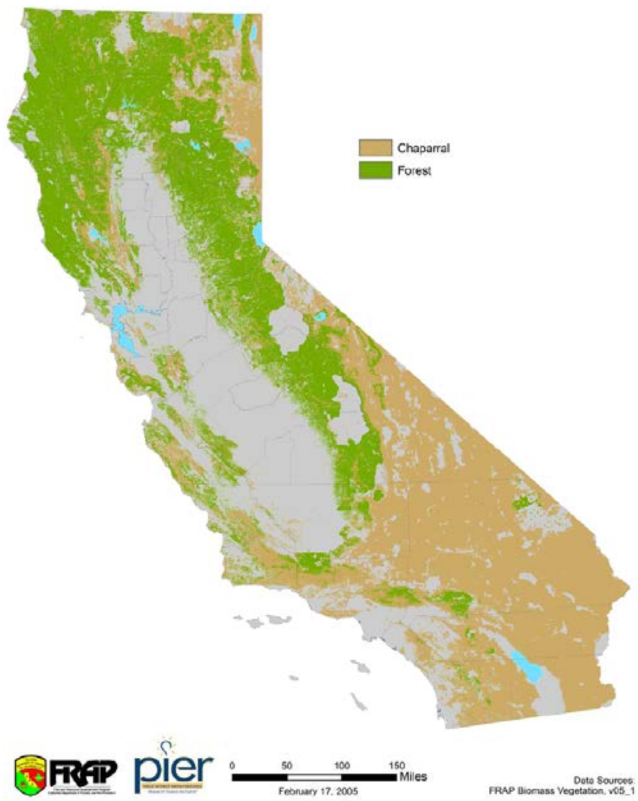

Figure 4.11.9 Gross potential area

Nearly half of what is potentially available as Gross becomes unavailable when environmental restrictions and other constraints are enforced (Figure 4.11.10). Specifically, when slope constraints, stream management zones, coastal protection zones, coastal sage scrub habitats, national parks, wilderness and other nature reserves are considered, the accessibility of available biomass declines significantly from approximately 26.8 million BDT/yr to 14.3 million BDT/yr (CEC and CAL FIRE, 2005; Williams, 2008) (Table 4.11.6).

Figure 4.11.10 Forest and shrublands technically available for biomass production

Table 4.11.6 Current estimate for gross and technically available biomass

Forest and Rangelands	Gross Potentially Available BDT/yr	Technically Available BDT/yr
Mill Residue	6.2	3.3
Forest Thinnings	7.7	4.1
Logging Slash	8.0	4.3
Chaparral	4.9	2.6
Totals	**26.8**	**14.3**

Previously published estimates of biomass in the Fire Threat Treatment Area (FTTA) suggest biomass availability at 3.1 million BDT/yr for non-merchantable material types, where 1.6 million BDT/yr are in the Wildland Urban Interface (WUI) (CEC and CAL FIRE, 2005). Assumptions were made regarding the area needing treatment, size and type of material removed per acre and the number of years over which treatments are completed. Specifically, the area needing treatments were classified (excluding reserves) into areas inside and outside the WUI that have high, very high or extreme fire threat (Figure 4.11.11). Annually, fire threat reduction treatments on State, local, and private owned lands both in and outside the WUI would yield an estimated a 2.2 million BDT/yr across all vegetation types on approximately 500,000 acres. Results of this analysis suggest approximately 3.1 million BDT/yr would result from the treatment of 14.1 million acres of eligible forest and rangelands (Table 4.11.7).

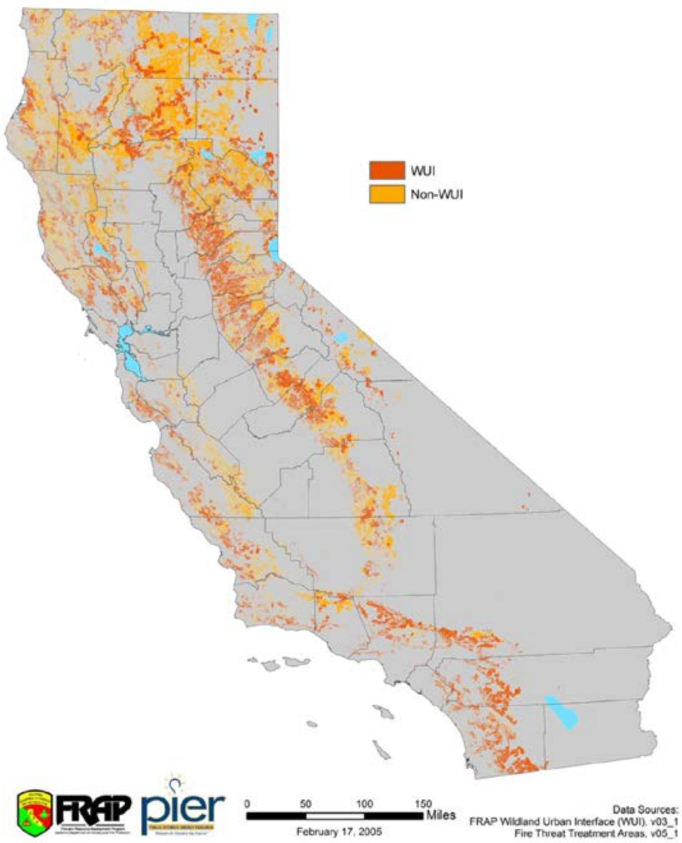

Figure 4.11.11 Fire Threat Treatment Area (FTTA)

Table 4.11.7
Estimated Annual FTTA Availability in millions

Ownership	FTTA Availablity BDT/yr
Private	2.3
Federal	0.78
State and Local	0.05
Totals	**3.1**

Finally, harvest residue availability based on existing commercial timber harvests is estimated 4.1 million BDT/yr (ibid). Harvest residue availability is a by-product of existing timber flows and silvicultural regimes, which were derived using a five-year average of timber harvest levels from

1999 through 2003 (ibid). The merchantable portion of the tree is used for higher-valued markets. Biomass is the residual portion of the tree that is too small for other markets and is otherwise piled and burned or left on the forest floor to contribute to nutrient cycling and soil development. Some evidence suggests a negative impact on soil nutrients and thereby future forest yields when harvest residues are utilized for biomass (White, 2010). State and Federal land management agencies have guidelines indicating how much biomass should be left on site for soil nutrients (Farr and Atkins, 2010). A full understanding of nutrient cycling with respect to harvest residues is site dependent and beyond the scope of this section, although numerous studies have investigated how forests grow, respond to thinning's, and are regenerated (Abbas et-al., 2011; Evans et al., 2010, Stewart et al., 2010). In any event, the State has a significant amount of harvest residue biomass available (4.1 million BDT/yr) from current harvesting activities. As previous figures and tables suggest there is tremendous biomass available on forest and rangelands with the potential to lessen wildfire threat through reduced fuel loadings.

Capacity, Status and Trends

This section shows that biomass utilization from forests and rangelands in California has varied significantly in past 30 years (Figure 4.11.12). In addition, an estimate of electricity production capacity for potentially available gross, technically available, FTTA and harvest residues is included. To understand where the biomass industry is going it is helpful to first grasp where it has been.

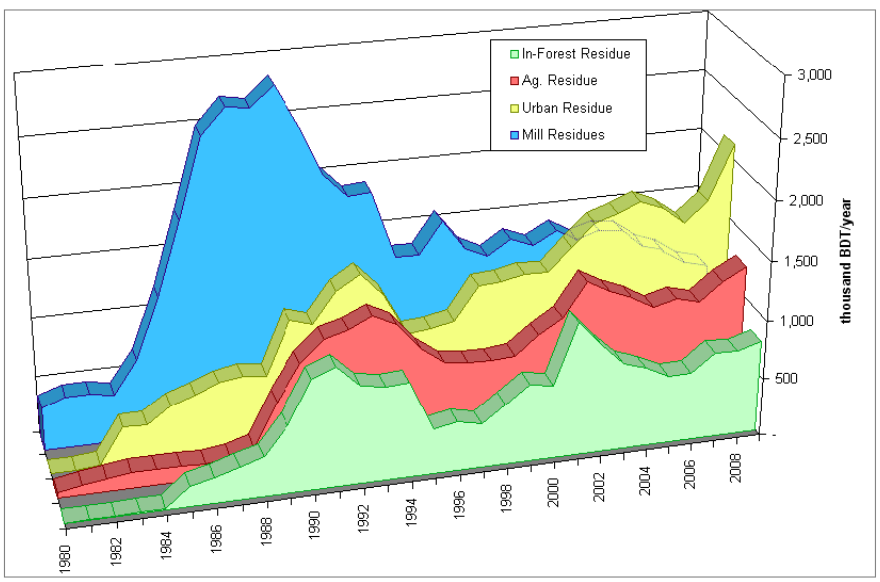

Figure 4.11.12 California fuels market by category (1980-2008) adopted from Morris, 2002

California's woody biomass supply presently has low market value when sold for energy wood chips. Throughout the 1980's California experienced a decade of growth in wood bioenergy (Morris 2000a). At its peak in the early 1990's the State had anywhere from 66 to 100 operating biomass power plants (Commission C.E., 2011a; Larson, 1993). Those plants were largely a result of incentives created by the Public Utilities Regulatory Policies Act (PURPA) of 1978 that required utilities to purchase electricity from cogenerators and other power producers at a price equal to the utilities' *avoided costs* (Baral and Guha, 2004; U.S. Government Accountability Office, 2006; Larson, 1993).[2] Today, purchasing utilities have to pay for the cost of their own generating capacity. Currently, there are approximately 33 existing biomass facilities (California Department of Forestry and Fire Protection, 2010). Looking forward, technologies and government incentive programs are steadily changing the commercial market for wood bioenergy and the market is growing (Evans, 2009; Kinoshita et al., 2009).

Today, California uses an unprecedented amount of bioenergy for electricity, with approximately 1 GW of installed operating capacity for all biofuel types (California Executive, 2006). It is estimated that 500 MW, or nearly half of which comes from forestlands (Commission C.E., 2011b). Currently, throughout California biomass energy provides 2.4 percent of all electricity used (Commission C.E., 2010c). Approximately half, or 1.2 percent, comes from forestlands. Estimates of the potential capacity for energy production from forest and rangelands vary by availability type and are shown in Table 4.11.8. Biomass energy from forest and rangelands will likely have to increase to achieve the State's 2013 renewable energy target of 20 percent of retail sales from renewables. Almost all of this generation takes place at larger scale plants. Biomass plants in California range from 5 MW to 50 MW of electrical generation capacity (Woody Biomass Utilization Group, 2011). Annual fuel requirements vary from 10,000 to 750,000 tons per year for facilities using conventional steam turbine technology (Morris, 2000a). Moreover, energy generation from biomass will have to increase significantly to meet the 2020 target of 33 percent of retail sales from renewable energy technologies.

Table 4.11.8
Estimated Potential Capacity by Non-Merchantable Availability Type

Biomass Availabilty	Power Capacity Potential MWe
Gross	3628.0
Technical	1963.0
FTTA	547.0
Harvest Residue	700.0
Totals	**6838.0**

If woody biomass is going to be a feasible tool to use in achieving the State's Renewable Energy Portfolio Standard (RPS), there must be a biomass energy facility within reasonable proximity to available biomass sources (CAL FIRE, 2010). The infrastructure requirements for biomass are unique when compared with other renewables since it is not constrained to producing electricity at the location of the renewable energy resource (Kriegler, 2010). Biomass can be shipped and stored for a relatively long period. However, for biomass facilities to be cost-effective, transportation costs must

[2] In this context, avoided costs are the energy and facilities costs that would have been incurred by the purchasing utility if that utility had to provide an equivalent generating capacity. According to the Federal Energy Regulatory commission, while it provides general avoided cost regulations, states set rates that often are above market rates.

be minimized. Additionally shorter transportation distance produces fewer carbon emissions, which is the larger objective of the State's RPS. Figure 4.11.13 shown below is a map of biomass facilities in California with a 25 mile buffer zone around each facility. The buffer zone provides a rough estimate of biomass availability that is commercially available at current costs (CAL FIRE, 2010).

Existing infrastructure also factors into overall transportation distance. If mills do not use residues on site to fuel their boilers and power their internal facility, the dollar value of mill residue is generally not high enough to justify long haul distances (Becker, 2011). To utilize mill residues for public energy production, trucks have to haul milling residues away from sawmills. The task of utilizing mill residues is made more difficult when the mature timber industry frequently closes mills, due to the link with volatile national housing trends (Power, 1996; pp. 131-148; Power, 2001, chp. 3; Power, 2006). Those ensuing closures result in increased hauling distance to the mills that remain. Fluctuating market values for alternate uses of wood chips, such as pulp, particle board etc., also affect the price paid for biomass (Becker, 2009). This factor further underscores the necessity to keep transportation costs low by locating biomass energy facilities in close proximity to harvesting sites so that maximum cost-effectiveness results.

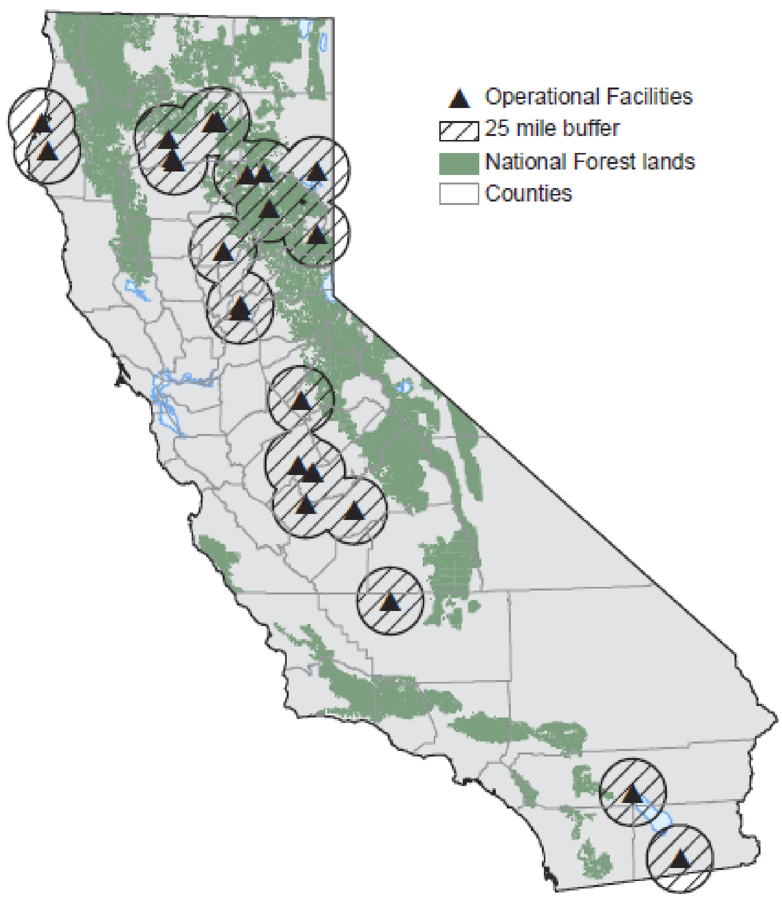

Figure 4.11.13 Operational biomass facilities in California

Utilities and Energy

Access to a consistently available biomass supply is commonly cited as the one of the largest constraints to the biomass energy industry (Becker et al, 2009b; Becker, 2011; Carriquiry, 2011). It is possible that if processing facilities were located in greater proximity to reliable sources of supply, forest biomass energy could begin to contribute to the State's renewable energy goals in a greater capacity.

To understand the implications of any given policy decision, land management practices or other factors that influences biomass utilization, it would be useful to analyze the precise volume and category of biomass currently being used in the fuel mixtures at bio-energy plants. Since that data is not yet clearly tracked, this offers future research opportunities to build a more thorough understanding of both availability and capacity.

Currently, less than a quarter of areas with high fire threat are near biomass facilities (CAL FIRE, 2010). The state has 15 million acres at very high fire risk, and 2.2 million acres at an extreme risk for wildfire (Zimny, 2004). Combined wildfire costs for local, State and Federal agencies across all land types in and outside the WUI annually average $900 million per year (California Energy Commission and Public Interest Energy Research, 2005). Estimates vary widely for fuel treatment costs per acre between $1000 and $1,800 dollars per acre (Klenner, 2009; Mason et al., 2006; Rummer, 2008). To treat the estimated 500,000 acres in the FTTA in and outside the WUI on private, local, federal and State lands would cost between $500 million and $900 million annually. This preliminary analysis suggests utilization of biomass in the FTTA provides a financial incentive, which corresponds to the avoided cost of future fire suppression.

Increased human settlement in the WUI increases wildfire risk (Schoennagel et al., 2009; Stockman et al., 2010). Treating those areas by removing fuels changes fire behavior and reduces risk of catastrophic fire (Schoennagel et al., 2009). Roughly two thirds of the potential forest and rangeland biomass is located on private lands that could potentially be affected by the VTP program. California law requires that the remaining wood waste from those treatments be burned or otherwise destroyed, since leaving it behind creates a more flammable and dangerous forest (California Department of Forestry and Fire Protection (CAL FIRE), et al., 2011). Since VTP residuals are typically pile burned, those fires generate emissions without capturing energy benefits. If they were instead combusted in a clean and efficient industrial manner to generate electricity, less CO_2 may be produced. More importantly, public energy consumption of fossil fuels could be significantly reduced by the use of forest waste as an alternative energy resource. However, estimations of the carbon balance vary widely and the resultant findings are anything but clear (Gunn et al., 2011). More research to fully evaluate all carbon inputs and the full lifecycle emissions of this technology is needed to understand and accurately calculate the positive impacts of using biomass to limit climate change. Nonetheless, utilizing biomass for fire risk reduction and residential area protection projects, such as the FTTA, offers significant opportunities that could result in low or no net CO_2 emissions, while contributing to the State's renewable energy goals.